Referee´s report on PhD. thesis of

Xiaoman Xiong

„Aerogel Embedded High-Performance Fibrous Materials“

Professor Miroslav Černík

The presented thesis consists of 119 pages divided into 5 major chapters plus References, Appendix and Research Outputs. The thesis deals with aerogel and fibrous materials. Chapter 1 is introduction to the problem, chapter 2 is state of the art in literature, chapter 3 deals with experiments, chapter 4 with results and discussion and chapter 5 is summary and conclusions.

Abstract/Abstrakt
The Ph.D. title in Czech is different than in English (word Fibrous is not translated) and also Czech translation of the English Abstract is written in problematic Czech language. So, the language should be checked by a native speaker.

Chapter 1
deals with a general introduction to the realized research work and author´s motivation.

Chapter 2
deals with State of the art. It is about heat transfer, properties of porous materials in thermal insulation and characteristics of fibrous thermal-insulating materials. Here pictures are reproducing from literature with adequate specification of sources, but w/o permission of the journals/authors. Also quality of some reprints is on the edge.

Chapter 3
deals with experimental part. Author compared 6 types of layered nanofibrous aerogel samples with various aerogel contents (A samples), 12 multi-layered samples with novel structure (middle layer with novel structure laminated on both sides) (P, Q, X samples), and polyester/polyethylene nonwoven fabrics treated with aerogel (B).

Chapter 4
includes details analysis of results. It starts with SEM images, thermal properties and ends with air permeability analysis for different fabrics. The results included here have descriptive characters, some deeper interpretations of the determined trends would increase their quality.

Chapter 5
includes summary of the work, conclusions and scope for future work. Here are general results of the work, but I would expected some detailed summarization of the work including determined dependencies and their generalization. I could be probably in previous chapter, where results are analysed, but not deeply interpreted.

Referee remarks, question and conclusions

QUESTIONS

1. Table 3.1 reports values and 95% confidence interval. How many parallel measurements of these parameters were done to get these statistics?
2. The section about microstructure of nanofibrous membranes (4.1.3.) stated: "…membrane consists of firebs in the submicrometer range arranged…", but Figures which should support this structure (Fig. 4.4 and 4.3) have scale bar of 100 μm (20 μm). Could you show the structure in the batter scale?
3. What is the thickness of nanofiber web (N) used for layered fabric preparation? From Table 4.1 it look that it is only 40 nm?
4. Theoretical model (p.52-3) does not describe the experimental data for low aerogel content. The difference is decreasing with increased amount of aerogel. Author explained this by underestimation of resistance since the thickness of the middle layer is decreased. Is not possible to determine thickness of this layer independently? By microscopy? Other measurement?

Imperfections and recommendations

The language and overall arrangement of the Ph.D. thesis in good and sufficient. These are few imperfection and errors in the text.

Example of imperfections:

- Units of thermal conductivity should be [W/(m.K)] not W/m.K (page 7), similarly h_c [W/(m^2.K)] not [W/m^2.K] (p.8);
- Pictures from SEM have no scale bar (4.1; 4.2)
- The values in confidence interval must have the number of decimal digits (not 6.2±0.01)
- Is it very difficult to follow data curves in some of the Figures (e.g. 4.24, the data points specifying lines are tiny and colours difficult to see).

Referee´s conclusion

The presented thesis of Xiaoman Xiong is logic, has all necessary parts and show the author understand her work and she is able to put results logically into appropriate parts. The work significantly contributes to knowledge in the subject. There are only a few recommendations for next author´s work. The language is good and fully understandable.

The thesis is good and meets all criteria to be taken to the defence.

Miroslav Černík

In Liberec (Czech R.) on May 10, 2019

Professor Miroslav Černík

Opponent´s review

Author of dissertation: Xiaoman Xiong, M.Eng.

Title of dissertation: Aerogel Embedded High-performance Fibrous Materials

The main aim of the dissertation is to study thermal performance of fibrous materials based on different types of aerogels.

The dissertation consists of 119 pages and is divided into 5 parts, appendix, references and research outputs. Work is written very well and contains only a few typing errors.

In the first part, the individual objectives of the experimental work are described and divided into 4 separate tasks. The first aim of this work is to study the thermal resistance of materials based on non-woven nanofibrous web and silica aerogel with thermal binding material. Furthermore, the author studied the use of laser engraving on the above samples without using thermal binding materials. Another group of materials studied for thermal properties was prepared using encapsulated aerogel. The last type of studied material was PUR and PVDF membranes produced by electrospinning.

In the dissertation thesis, the author set out the objective of evaluating different evaluation methods for the determination of thermal properties in the above samples. Evaluation of choosing methods of thermal performance determination is the last aim of this work. The second part of this thesis deals with research of current knowledge in the field of thermal transfer and its evaluation. Characteristics and using of selected insulating materials is also described in this part. The third chapter, experimental part of dissertation, describes the procedures used to prepare individual samples of insulators and also the procedures for evaluating not only thermal performance these samples. The following methods have been selected for material structure evaluation: SEM, digital microscope, thermal performance methods: TGA, DSC, Alambeta, IR camera ThermaCAM TV300, KES FT II Thermolabo tester, measuring of convective heat and method for compression properties testing.

Fourth part of thesis contains results, which are very well organized and discussed in detail. The fifth part summarizes the partial conclusions from previous part and contains suggestions for future of research in this area.

In this dissertation many experiments were carried out with different types of materials. The author appropriately selected the evaluation methods. This work gives a very good overview of the possibilities of using materials based on aerogel in the field of thermal resistant materials. The author's publication activity is sufficient. The results of her thesis were published in 11 journals, 5 chapters of books and presented at 7 international conferences.

Questions for defense:

1. Why did you choose as a preheat temperature at 60 °C?
2. Why the thermal behavior under convection were determined only for samples B and Q? I am missing results for other samples based on Struto nonwovens.

In conclusion I recommended this dissertation for the defense.

In Pardubice 14th May 2019

Ing. Michal Černý, Ph.D.